DIGITAL TECHNOLOGIES IN EARLY CHILDHOOD EDUCATION SERVICES: PEDAGOGICAL REFLECTIONS ON THE INCLUSION OF DEAF CHILDREN

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Double Blind Peer Review

Citation
Veneruso, U., & Di Gennaro, D. C. (2026). Digital Technologies in Early Childhood Education Services: Pedagogical Reflections on the Inclusion of Deaf Children. *Italian Journal of Health Education, Sport and Inclusive Didactics*, *10*(4).
https://doi.org/10.32043/gsd.v10i4.1869

Doi: https://doi.org/10.32043/gsd.v10i4.1869

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renpress.it/index.php/gsdj
ISSN: 3103-5744

ABSTRACT
The presence of digital technologies in early childhood education and care services has progressively moved beyond both technodeterministic interpretations and radically resistant positions, moving instead toward a more mature approach capable of reconnecting the use of digital tools to educational intentionality, the specificity of contexts, and the central role of the adult as mediator. This approach becomes particularly relevant when considered from an inclusive perspective, with specific reference to deaf children and to the communicative, relational, and linguistic characteristics that shape their experiences within educational settings. Indeed, deafness calls for the design of accessible and participatory learning environments, in which the plurality of communication channels, the attention to the visual dimension and the intentional organization of interactions can support the active involvement of all children. In this sense, digital technologies may represent a significant pedagogical resource, not merely as compensatory tools, but as devices capable of enhancing the interpretation of routines, supporting joint attention, broadening access to experience, and promoting inclusive processes. Starting from these premises, this contribution aims to offer a theoretical reflection on the use of digital technologies in early childhood education settings, highlighting their potential in relation to deafness and emphasizing the need for rigorous professional mediation and the intentional design of spaces, times and interactions.

KEYWORDS
Inclusion of Deaf children; Digital technologies; Early childhood education services.

Received 2026-07-10
Accepted 2026-10-27
Published 2026-10-30

1. Introduction

Educational design in early childhood education services is today one of the most significant aspects for rethinking inclusion. It is not merely a matter of placing the child within an environment, but of intentionally creating spaces, relationships, times, materials and mediations that enable all children to participate actively (Aiello, 2023). From this perspective, the nursery is not only a place of care or custody, but a rich and complex educational context in which every aspect contributes to shaping the child's experience. This includes the organisation of spaces, the quality of daily routines, the arrangement of materials, the role of the educator, interactions with peers, pedagogical documentation, play, movement, narration and the opportunity to explore meanings through different languages (Bondioli & Savio, 2018; Restiglian, 2012; Zappalà, 2023).

Within this context, the presence of children with hearing disabilities stimulates deeper reflection on the quality of communication within the educational environment. Deafness and hearing problems cannot simply be viewed as sensory issues, nor can they be understood solely as the loss or reduction of the ability to hear. These conditions involve linguistic, relational, communicative, identity-related, social and contextual dimensions, and therefore require a pedagogical approach capable of recognising the complexity of the child's functioning and the importance of environmental mediations (Gaspari, 2019; AA.VV., 2020; World Health Organization, 2021). From this perspective, educational attention does not focus only on what the child cannot hear or perceives only partially, but above all on the conditions that can make routines, games, narratives, interactions, rules, transitions and meanings accessible. In the early years of life, communicative and linguistic development is closely connected to the quality of everyday relationships. Young children construct meanings through the body, gaze, gestures, facial expressions, movement, contact, imitation, repetition, object manipulation and participation in shared rituals. Before becoming fully verbal, communication is an embodied, situated and relational experience. In the case of hearing disability, this dimension requires even more targeted educational attention, since much of the information that is implicitly conveyed in ordinary contexts through the oral or auditory channel must be made visible, predictable, shared and accessible through a variety of codes (Vygotskij, 2009; Maragna, Roccaforte, & Tomasuolo, 2013; Aiello, 2023).

The nursery can play a decisive role precisely because it represents one of the first social environments outside the family in which the child experiences belonging, participation and relationships within a group. The quality of this experience does not depend solely on the affective availability of adults, but on the service's ability to create genuinely accessible educational conditions. A routine that is not anticipated, a verbal prompt not accompanied by a gesture, a narrative entrusted only to the voice, an activity organised without visual supports, or a noisy and poorly legible environment may create significant barriers for deaf or hard-of-hearing children. Conversely, an orderly, visually clear and communicatively rich space, supported by bodily, gestural, iconic and material mediations, can foster security, autonomy and participation (AA.VV., 2015; Bianquin & Bulgarelli, 2022; Aiello, 2023). Inclusive design in the nursery therefore requires overcoming a merely adaptive logic. It is not a matter of occasionally adding a tool or providing an individual support for the child with hearing disability, but of rethinking the entire educational environment so that communication becomes a widespread and accessible dimension. Inclusion, in this sense, does not coincide with the child's physical presence within the group, but with the possibility of understanding what is happening, taking part in play, sharing routines, interacting with peers, expressing preferences, anticipating transitions and gradually developing a sense of belonging (Chiappetta Cajola & Rizzo, 2014; Bulgarelli, 2018; Aiello, 2023).

In this scenario, digital technologies may be considered, but only as one of many possibilities within pedagogical design, not as the core of the educational experience. In services for children aged 0 to 3, digital technologies cannot replace body, play, relationships, manipulation and direct experience with materials. They can acquire value only when integrated into rich, concrete, relational and multisensory educational environments, where the adult plays an active and reflective role (NAEYC & Fred Rogers Center, 2012; Di Bari & Mariani, 2018; Dini & Ferlino, 2016). Therefore, attention should not be focused on the digitalisation of the nursery, but on the design of spaces in which some digital tools, used in a limited and mediated way, can enrich experience, help visualise sequences and foster the participation of children with hearing disabilities. This perspective helps avoid two opposite risks. The first is to consider digital technologies as an automatic solution to inclusion-related issues, attributing to them a compensatory capacity that, in reality, always depends on the quality of educational design. The second risk is to exclude technology completely from early childhood contexts, forgetting that

some devices, if used with moderation, intentionality and in combination with concrete materials, can promote accessibility and participation. Thus, digital technologies should not be viewed as a substitute for the physical environment, but as a possible element within a broader design centred on spaces, times, materials, relationships and different languages (Cranmer, 2021; Bonarini & Jansens, 2020; Torres et al., 2021).

2. Hearing disability in early childhood educational contexts

Hearing disability encompasses a wide range of conditions, each with its own characteristics in terms of degree of hearing loss, time of onset, modes of communication, use of assistive devices, family context, educational experiences and developmental pathways. When referring to children with hearing disabilities, it is essential to avoid generalisations and recognise the diversity of their individual functioning. Some children have mild, moderate, severe or profound hearing loss; some use hearing aids or cochlear implants; others communicate mainly through oral language, while some use sign language. Some grow up in hearing families, others in deaf families, and some children also present additional developmental needs. This variety requires an educational approach based on observation, understanding of the child and the creation of flexible and accessible contexts (Gaspari, 2019; AA.VV., 2020; World Health Organization, 2021).

Deafness does not follow a linear developmental path; it may affect access to auditory information, spontaneous oral communication, incidental conversations, the management of routines and participation in social experiences. Many hearing children learn a significant part of everyday meanings simply by listening to what surrounds them: prompts, comments, explanations, instructions, words addressed to others, environmental sounds and signals indicating the beginning and end of activities. By contrast, a deaf or hard-of-hearing child may have limited or partial access to this dimension of communication. For this reason, it is important that the nursery make the information that organises the everyday life of the group more explicit, visible and shared (Maragna, Roccaforte, & Tomasuolo, 2013; AA.VV., 2015; Aiello, 2023).

In the early years of life, access to communication is fundamental for linguistic, cognitive, affective and social development. Early communicative experiences are not limited to the exchange of words; they also involve the sharing of

attention, intentions, emotions, objects, gestures and meanings. Language development takes place within meaningful relationships and through social interactions that enable the child gradually to assimilate cultural tools and ways of thinking (Vygotskij, 2009). In the case of hearing disability, particular attention must be paid to the educational relationship, the visibility of the face, the clarity of gestures, the stability of routines and the possibility of accessing meanings through different codes. Early identification of hearing loss and the timely activation of educational and rehabilitative interventions are associated with better communicative and linguistic outcomes for deaf or hard-of-hearing children (Yoshinaga-Itano, Sedey, Coulter, & Mehl, 1998; Moeller, 2000; Joint Committee on Infant Hearing, 2019). However, these findings should not be considered only from a clinical perspective. They also recall the pedagogical responsibility of early educational contexts, which must provide rich, accessible and relationally meaningful communicative opportunities on a daily basis. The nursery does not replace specialist interventions, but it can be a crucial environment for strengthening access to communication, supporting interaction with peers and promoting participation in the group's everyday experiences (Restiglian, 2012).

Communication within the nursery should be understood as an ecosystem. It does not concern only the moment in which the educator speaks directly to the child, but the entire organisation of the educational day. Each phase, from arrival to changing, from lunch to sleep, from free play to structured activities, through to tidying up and departure, is rich in meaning. In these moments, the child has the opportunity to understand, anticipate, participate and build trust. In the case of hearing disability, it is essential to make each routine recognisable through stable rituals, coherent gestures, reference objects, images, facial expressions, adult postures and a clear visual organisation of the environment. Predictability does not limit the educational experience, but provides the child with a solid basis of security from which to explore, communicate and interact. The socio-emotional dimension is also crucial. When communication is not accessible, the child may feel frustrated, disoriented, isolated or may experience difficulties in regulating emotions. These behaviours should not be interpreted as individual traits of the child, but rather as signs of a mismatch between the child's communicative needs and environmental conditions. An inclusive educational context must therefore reflect on its own barriers: does the child know when a new activity is about to begin? Can the child anticipate the end of a game? Is the child able to grasp the adult's intentions? Can the

child take part in group conversations? Does the child have the tools to express preferences, refusals, emotions and needs? Can the child interact with peers without always depending on the adult's translation? These questions help shift attention from individual deficit to the quality of the educational environment (Bianquin & Bulgarelli, 2022; Aiello, 2023).

Play is a privileged context for observing and promoting inclusion. In the nursery, play is not a secondary activity, but a fundamental form of knowledge, communication and relationship. Through play, the child has the opportunity to explore objects, experiment with roles, build turn-taking, imitate, negotiate, wait, share and give meaning to experiences. When children with hearing disabilities are present, it is important to design play in such a way as to facilitate access to implicit rules, the understanding of peers' intentions and active participation. The use of visually clear materials, concrete objects, well-organised spaces, imitation games, symbolic activities supported by images and gestural routines can effectively promote interaction and reduce the risk of isolation (Chiappetta Cajola & Rizzo, 2014; Bulgarelli, 2018). Peer participation is fundamental for inclusion. A child with hearing disability should not be confined to an exclusive relationship with the adult, since a sense of belonging to the group is built through shared experiences with other children. Peers can become natural facilitators if the educational environment encourages different communicative modes, such as shared gestures, images, symbolic objects, visual turns, songs accompanied by movements, bodily games, narratives with iconic supports and small-group activities. In this way, strategies designed to support the deaf or hard-of-hearing child do not remain isolated tools, but become a shared resource for the group. Communicative diversity does not limit the experience of other children; rather, it enriches it by expanding ways of understanding, expressing and sharing (Bonarini & Jansens, 2020).

The educator, especially in the presence of children with hearing disabilities, plays a crucial mediating role. This professional role goes far beyond affective care; it is expressed in the ability to observe, design, organise and rethink the environment. It is essential that educators be able to identify communication barriers, value facilitators, prepare accessible materials, organise small groups, encourage peer interactions, make routines clear and use different languages. All of this requires a reflective and contextualised educational approach, in which professionalism translates into the ability to make flexible and situation-appropriate decisions, based on reflection-in-action and the continuous

reorganisation of intervention (Schön, 1983). The quality of education largely depends on professional sensitivity in creating contexts that respond to each child's developmental and relational needs. In this sense, educational work requires pedagogical, inclusive and communicative competences, as well as the ability to collaborate with pedagogical coordination and with the specialist figures accompanying the child's pathway (Bondioli & Savio, 2018; Restiglian, 2012; Aiello, 2023).

Educational design in nurseries must be careful to avoid two pitfalls. The first is assimilation, namely the implicit expectation that a child with hearing disability should adapt to an environment designed mainly for hearing children. The second is separation, which occurs when activities or supports are created exclusively for the child, thereby risking isolating the child from the rest of the group. Inclusion, instead, requires common yet diversified spaces, capable of anticipating from the outset multiple modes of access, languages and forms of participation (Aiello, 2023). In this context, the presence of a child with hearing disability may represent an opportunity to enhance the overall quality of the service, making the environment clearer, more communicative and more attentive to different ways of learning and participating (Bulgarelli, 2018; Bianquin & Bulgarelli, 2022). This means building contexts that welcome individual differences and offer rich and meaningful learning experiences (Di Gennaro, 2023).

3. Designing learning environments with digital technologies in early childhood education services in the presence of children with hearing disabilities

The design of spaces is one of the key elements for ensuring high educational quality in nurseries. Space is not a simple container, but a genuine pedagogical tool that influences relationships, autonomy, exploration, movement, communication and opportunities for participation. The arrangement of furniture, the choice of materials, the clarity of the different areas, the stability of routines, the presence of visual cues, sound quality, lighting and freedom of movement all play a crucial role in the way children experience their educational environment. A well-designed space conveys intentionality, care and a clear pedagogical identity; by contrast, a disordered, overloaded or unclear space may generate confusion and obstacles (Weyland & Galletti, 2018; Bondioli & Savio, 2018; Zappalà, 2023).

In the presence of children with hearing disabilities, it is essential to design space with communicative accessibility in mind. This means creating environments in which information is not based only on adults' voices or on sounds, but is made visible through objects, images, gestures, sequences, photographs, postures, routines and materials. The environment must help children understand where they are, which activity they are carrying out, what will happen next, which materials they can use, which rules govern play and how they can participate. The clarity of space does not concern only physical order, but also the possibility of accessing the meanings of everyday life in the nursery (Maragna, Roccaforte, & Tomasuolo, 2013; Weyland & Galletti, 2018; Aiello, 2023). Moreover, the temporal dimension is closely linked to the spatial one. In the nursery, the moments of the educational day are not merely organisational subdivisions, but affective and cognitive structures that help the child orient themselves. The predictability of routines provides security, autonomy and participation. For a child with hearing disability, it is particularly important to anticipate the transition from one activity to another, understand the beginning and end of a game, and recognise the moments of lunch, changing or rest. Visual panels, real photographs, reference objects, clear gestures and illustrated sequences can support this temporal organisation, preventing the child from depending only on verbal instructions that may not be fully accessible (Restiglian, 2012; Zappalà, 2023; Bianquin & Bulgarelli, 2022).

The acoustic quality of spaces is a fundamental aspect to consider in educational design. In services for children aged 0 to 3, background noise can be quite high and constant. Overlapping voices, sounds from toys, chairs being moved, crying, calls and simultaneous activities may make comprehension difficult for a child with hearing loss, even when the child uses hearing aids or a cochlear implant. Educational design must therefore take into account the need to reduce noise, organise small groups, create more intimate areas, facilitate direct communication, pay attention to communicative distance and use visual cues to attract attention. Acoustic accessibility is not merely a technical issue, but an essential pedagogical condition for participation (World Health Organization, 2021; Joint Committee on Infant Hearing, 2019). In this context, digital technologies may be integrated into the design of spaces, but only if they remain at the service of the quality of the educational experience. In early childhood services, digital technologies must not replace tangible materials, bodily interactions, manipulation, symbolic play and face-to-face

communication. Nevertheless, they can become useful tools for making sequences more visible, facilitating access to certain narratives, clarifying routines and making some group experiences more shareable. The central issue is not simply to introduce technologies into the nursery, but to understand under what conditions they can support inclusive design without compromising the bodily, sensory and relational dimensions of the child's experience (NAEYC & Fred Rogers Center, 2012; Di Bari & Mariani, 2018; Dini & Ferlino, 2016).

A hybrid educational environment is not simply a space filled with screens, but rather a place where analogue and digital elements are harmoniously intertwined. Digital technologies can accompany materials, objects, images, gestures and narratives without ever replacing them. For example, a digital photographic sequence can accompany a concrete routine; a short video can introduce a new activity; an enlarged image can facilitate the understanding of a picturebook; an interactive panel can make some play choices visible; and a simple visual recording can help the group remember a shared experience. The educational value of these tools lies in their integration with the physical environment and in the support provided by adults (Torres et al., 2021; Chu, 2024; Bourbour, 2023). For children with hearing disabilities, digital technologies can be particularly useful for visualising meanings. Information that is usually communicated orally can be made accessible through images, photographs, symbols, short visual sequences and multimodal supports. However, it is essential that this use be moderate and targeted. The environment must not be invaded by screens or excessive visual stimuli. A visually accessible context is characterised by order, clarity, coherence and selectivity. Images and digital supports must have a specific purpose, be placed in meaningful points of the space and become an integral part of educational routines (Weyland & Galletti, 2018; Zappalà, 2023; Aiello, 2023).

The design of educational areas can greatly benefit from this integration. For example, in the reading corner, digital technologies can enrich the experience of picturebooks with enlarged images, visual sequences and short multimodal supports, always in the company of the educator, who fosters interaction with the group through gestures, expressions and narrative objects. In the symbolic play corner, photographs and images can help children recognise roles, objects and actions, making it easier for children with hearing disabilities to participate in pretend play. In the manipulation area, digital technologies can document or make certain steps visible, but the main experience remains that of the body touching, exploring, transforming and constructing. In the routines area,

images and sequences can support temporal orientation and the understanding of transitions (Bulgarelli, 2018; Chiappetta Cajola & Rizzo, 2014; Restiglian, 2012). If a tablet is present, it must be used as a tool of adult mediation rather than as a simple object for individual entertainment. In services for children aged 0 to 3, passive and prolonged screen use does not align with young children's developmental needs, as they require movement, active play, relationships, adequate sleep and direct interaction (World Health Organization, 2019). Nevertheless, brief, shared and targeted use can enrich certain educational experiences: choosing between two images, observing a routine sequence, reviewing an activity just completed, participating in a visual narrative, or recognising objects or peers in photographs connected to nursery life. In these cases, the device does not replace the educational relationship, but supports it within a clearly defined project (Neumann, 2016; Oliemat, Ihmeideh, & Alkhawaldeh, 2018; Chu, 2024).

The educator's mediation is fundamental. No tool, whether analogue or digital, is intrinsically inclusive. An image may be of little significance if it is not part of the daily routine; a tablet may become a barrier if it isolates the child; a visual panel may be ineffective if it is not used consistently; an environment rich in materials may be confusing if it is not well organised. The educator must carefully observe the child, understand which tools are genuinely accessible, organise small groups, facilitate participation, support joint attention and rethink spaces on the basis of the responses observed (Bondioli & Savio, 2018; Restiglian, 2012; Aiello, 2023). Pedagogical coordination also plays a crucial role. The inclusion of digital technologies in the design of spaces cannot be left to the individual action of a single educator, but must be part of a shared approach within the service. It is essential to define aims, timing, selection criteria, modes of use, limits, ethical considerations and coherence with the educational project. When children with hearing disabilities are present, coordination can support the educational team in creating a culture of communicative accessibility, avoiding sporadic interventions or improvised solutions. Inclusive design requires continuity, co-responsibility and constant professional reflection (Weyland & Galletti, 2018; Zappalà, 2023; Aiello, 2023).

It is essential to emphasise that digital technologies should not be seen only as a means of external communication or documentation, but should above all concern the quality of design within the nursery. The focus must remain on educational spaces, materials, routines, times, play, interactions and mediations that enable children with hearing disabilities to participate actively

in group life. From this perspective, digital technologies may prove useful for improving access to experiences, but they must not shift attention away from the educational relationship towards the production of content or the management of external communication. The design of spaces through digital technologies must therefore follow certain pedagogical criteria. The first is intentionality: each tool must have a clearly defined educational aim. The second is concreteness: digital technologies must remain connected to real objects, materials, gestures and routines. The third is sharing: the use of the tool must promote interactions with adults and peers, avoiding isolation. The fourth is accessibility: information must be clear, comprehensible and usable by children. The fifth is moderation: the timing, frequency and intensity of use must respect the developmental needs of young children. Finally, the sixth is evaluation: the tool should be retained only if it genuinely supports participation, autonomy and understanding (NAEYC & Fred Rogers Center, 2012; World Health Organization, 2019; Cranmer, 2021; Chu, 2024).

In this scenario, inclusive design in nurseries does not require cutting-edge technologies. Often, simple tools that are well integrated into the environment are sufficient: real photographs of spaces, visual sequences of daily routines, images to support activity choice, storytelling supports, orderly panels and short visual contents arising from the concrete experience of the group. Pedagogical quality is not measured by technological complexity, but by the ability to create environments in which children can understand, act, communicate and participate. When digital technologies are present, they must remain a light support, at the service of the educational experience and not a substitute for it (Dini & Ferlino, 2016; Di Bari & Mariani, 2018; Aiello, 2023). The design of spaces in nurseries, especially for children with hearing disabilities, must therefore consider three fundamental aspects: communicative accessibility, play-relational quality and environmental intentionality. Communicative accessibility enables the child to understand and participate; play-relational quality ensures that the experience remains anchored in play and relationships; environmental intentionality transforms the space into a clear, welcoming and varied educational context, functioning as a “third educator” (Malaguzzi, 1995). Digital technologies may enter this framework as one of the many languages of design, never as an autonomous or substitutive solution, promoting a flexibility of context that guarantees participation, respects each child’s unique times and modes of interaction with

the world, and recognises the child as an active social actor (Goldschmied & Jackson, 1997; Pennazio, 2017).

Conclusions

The presence of children with hearing disabilities in early childhood education services requires a pedagogical approach that deeply explores the quality of spaces, times, materials, routines and communicative modes. Deafness and hearing loss cannot be seen only as sensory conditions, but must be understood within the interaction between the child and the surrounding environment. Barriers do not arise only from hearing loss, but also from unclear environments, communication based exclusively on voice, unanticipated routines, noisy spaces, inaccessible materials and limited opportunities for interaction with peers (Gaspari, 2019; AA.VV., 2020; World Health Organization, 2021). The nursery can become an inclusive place when communication is regarded as a fundamental dimension of the educational environment. This means creating orderly, recognisable and visually clear spaces; establishing predictable routines; using gestures, images, objects and sequences; valuing play; caring for relationships among children; and relying on educators capable of observing and mediating. Inclusion is not limited to the addition of special tools, but involves transforming the context into an environment that offers multiple ways of accessing experience (Bulgarelli, 2018; Bianquin & Bulgarelli, 2022; Aiello, 2023).

In this context, digital technologies may play a limited but important role, especially if they are not viewed as an automatic solution or as a substitute for physical, material and relational experience. In services for children aged 0 to 3, technologies must be used with caution, intentionality and moderation, always within a project that places play, the body, manipulation, relationships and active participation at the centre (NAEYC & Fred Rogers Center, 2012; World Health Organization, 2019; Di Bari & Mariani, 2018). For children with hearing disabilities, some digital tools can help make routines more visible, sequences more accessible, some stories more shareable and certain aspects of the educational experience clearer, but only if they are accompanied by concrete materials and adult support (Torres et al., 2021; Chu, 2024; Cranmer, 2021). The design of nursery spaces through the use of digital technologies must therefore be conceived as part of a broader pedagogical culture of accessibility. It is not a matter of digitalising the service, but of creating hybrid, flexible and intentional environments in which analogue and digital elements

can interact without one replacing the other. An inclusive space is a space that educates, because it communicates, welcomes, orients, supports and makes participation possible.

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